



Lab4Schools Lab Activity "ERMET"

Innovative Lab Infrastructure for Schools

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Erasmus+ Programme of the European Union

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GOAL	You have to be able to :
	 Create a GRAFCET order from a set of specifications then download it to an automaton.
WHAT YOU HAVE TO WORK ON	 Create an adressing input and output table. Create a program with « SoMachine » Transfer this program. Test the program.
TOOLS NEEDED	 Computer with the software « SoMachine » The model of the ERMET « SoMachine » instructions booklet.

PRESENTATION



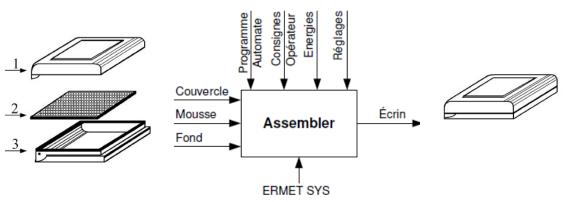
TP BTS CRSA

• The ERMET system is a production system extracted from a jewelry box packaging machine.

As configured, the machine is used to assemble jewel cases to receive costume jewelry on a packaging line.

• Main work material and modeling.

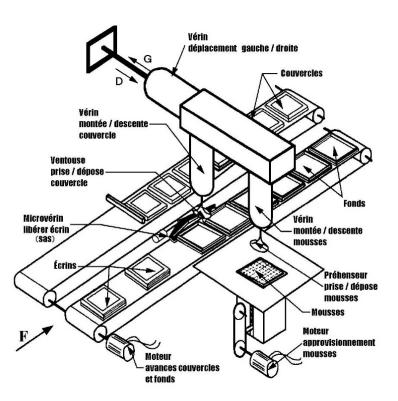
The system receives three parts (1 the lid, 2 the foam and 3 the bottom) before the assembly operation. These three parts form the case.



Architecture of the packaging system.

The conditioning system has :

- A belt for the arrangement of the bottoms. This same belt is also used for the evacuation of finished cases.
- A conveyor belt for the lids.
- A device for gripping the lids. This same device is used to to fit the lids on the bottoms.
- A device for gripping the foams. These foams are stored in a a magazine.
- A transfer device allowing :
 - The transfer of the lids on the bottoms.
 - The transfer of the foams on the bottoms.



• Operation of the conditionning system: Station n°1 : Lid gripping (Cylinder 4C)

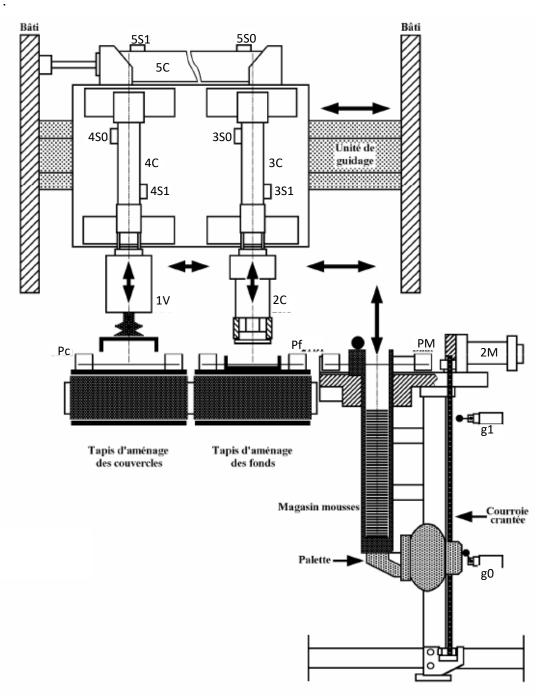
A pneumatic cylinder equipped with a suction cup comes to seize a lid on the belt of arrangement and emboîte it on a bottom at the level of the belt of arrangement of the funds.

Station n°2 : Foam gripping (Cylinder 3C)

A cylinder equipped with a gripping device picks up a foam filling stored in the "foam magazine" and places it in a bottom at the level of the bottom fitting belt.

Station n°3 : Transfer device. (Cylinder 5C)

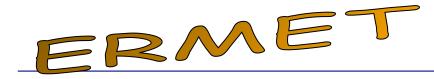
A linear translation unit driven by a pneumatic cylinder allows the transfer of the foams in the bottoms and the transfer of the lids on the bottoms.



• Nomenclature :

natures Type Code Adresse boulon pousoir Adresse boulon pousoir Sélecteur 3 positions avec rappel Sélecteur 3 positions avec rappel Sélecteur 3 positions avec rappel Voyant condinitales Voyant arrêt d'urgence Voyant manque mousseir Voyant manque Voyant arrêt d'urgence Voyant manque Voyant oubrosoir <th>Ordre Pre-actionneurs</th> <th>Informatio</th> <th>Intormations Capteurs/IHM</th> <th></th>	Ordre Pre-actionneurs	Informatio	Intormations Capteurs/IHM	
	Code	Informations	Tvpe Code	Adresse
			Départ cycle	0.0XI%
			Arrêt d'urgence	9.0XI%
			initialisation	%IX0.3
			Réarmement	%IX0.5
			coup/coup	%IX0.2
			auto	%IX0.1
			Chariot Gauche	e %IX0.7
			Chariot / Droite	e %IX1.1
H H H H H H H H H H H H H H H H H H H			Validation magasin mousse	%IX0.4
日本1997日 日 日 日 日 日 日 日 日 日 日 日 日 日 日 日 日 日 日	H7	%QX0.6	-	-
H H H H H H H H H H H H H H H H H H H	/ \ 91	X		
H3 H	H5	%QX0.7		
H3 H3	4 V	X		
H2	H3	%QX0.4		
	H2	%QX0.5		
voyant arrêt H1 %QX1.3	H1	%QX1.3		

Nomenclature des taches		Projet: ERMET	RMET						
Tachoo	Actionneurs		Ordre Pré-actionneurs	onneurs		luf	Informations Capteurs/IHM	MHI	
acties	Type	Code	Type	Code	Adresse	Informations	Type	Code	Adresse
Descendre/monter préhenseur	vérin double offet	Je	distributeur 5/2 monostable à	3D	%QX3.1	Tige Sortie (bas)		3S1	%IX2.0
mousse		3	commande électrique	\bigwedge	V	Tige rentrée (Haut)		3S0	%IX2.1
Dréhoneion morreeo	uốnia doubla offict (ninco)	JC	distributeur 5/2 bistable à	2D+	%QX1.5				
	אפווון מסממים פוופר (מוויכפ)	3	commande électrique	2D-	%QX3.0				
Monter/descendre préhenseur	منفضه طمنامات ملقمه	ç	distributeur 5/2 monostable à	4D	%QX3.2	tige sortie (bas)	contour II C	4S1	%IX2.3
couvercle		\$	commande électrique	\wedge	V	Tige rentrée (haut)	capieul ILO	4S0	%IX2.2
Dráhowsion controralo	oónórotour à vido Monturi)	Ş	distributeur 5/2 monostable à	1D+	%QX3.7				
	yenerateur a vioe (venturi)	2	commande électrique	1D-	%QX1.4				
Dévlacement horizontal du blac	uốnin doublo offict	د ي	distributeur 5/2 bistable à	5D+	%QX3.5	tige sortie (droite)	contour II C	5S1	%IX2.4
		R	commande électrique	5D-	%QX3.6	tige rentrée (gauche)	rahterii II-O	5S0	%IX2.5
Várin Sac	vérin double affet	g	distributeur 5/2 bistable à	6D+	%QX3.3	tige sortie (sas fermé)	capteur ILS	6S1	%IX1.0
		3	commande électrique	6D-	%QX3.4				
Converse foodfoor morelo	Motour Conchrono	Ą	ai noporganoo	KMT	0.170%	présence couvercle	Capteur à fibre optique à proximité	Pc	%IX1.2
			collidered		0.100%	présence fond	Capteur à fibre optique à proximité	F	%IX1.3
				KMMO	%QX1.2	Magasin mousse en haut	Capteur à galet	g1	%IX1.5
Distribution mousse	Moteur courant continue	2M	contacteur	KMDE	%QX1.1	Magasin mousse en Bas	Capteur à galet	06	%IX1.6
				\wedge	\bigvee	Présence mousse	Capteur à fibre optique à barrage	PM	%IX1.4
Contacteur de sécurité			contacteur	KMPO	%QX1.6	Contacteur enclenché		KMP0_enclenchee	%IX0.6



Phase 1 : Having a look around at your job

As you can see, the system is already wired.

The control part of your station is composed of a SCHNEIDER M241 programmable logic controller (PLC).

The operating part will only be used in part (1 or 2 actuators and their sensors).

Locate on the station all the elements participating in the action and acquisition chains relating to the actuators used.

Phase 2 : Writing the grafcets

Being interested only in one cylinder, you will program a pendular cycle. That is to say that the stem of the jack will have to leave until the end of race then to return to its initial position. The triggering of the cycle will be done by the activation of the button start cycle " dcy ".

2.1 - After having analyzed the nomenclature of the system, on sheet of copy, to draw up the table of the inputs/outputs (name, mnemonic, assignment API) only of the necessary elements. Note: You will add the output variable "KMPO" of the safety contactor necessary for the operation of the machine.

2.2 - On a copy sheet, write the grafcet point of view PC.

2.3 - With the help of appendix 1, establish the program from your PC Grafcet and your input/output table on the SoMachine software.

2.4 - Call the teacher to upload your program in the PLC.

2.5 - Test your program in the presence of the teacher.

Phase 3 : Including a TEMPORIZATION part

The pendular cycle is the same as before but the rod of the jack will have to go out until the end of race and to remain in position during 3 seconds then to return to its initial position.

3.1 - On a sheet of paper, write the new PC Grafcet.

3.2 - With the help of appendix 2, modify the program from your PC Grafcet on the SoMachine software.

3.3 - Test your program in the presence of the teacher

Phase 4 : Including a COUNTER part

The pendular cycle is the same as before but it must be executed 3 times then stopped until the presence of the cycle start appears again.

- 4.1 On the copy sheet, write the new PC Grafcet.
- 4.2 Using appendix 3, modify the program from your PC Grafcet on the SoMachine software.
- **4.3** Test your program in the presence of the teacher.

Phase 5 : Programming a more difficult cycle (given by the teacher)

- **5.1** On a copy sheet, write the new PC Grafcet.
- **5.2** Modify the program from your PC Grafcet on the SoMachine software.
- **5.3** Test your program in the presence of the teacher.

ANNEXE 1 – API Configuration and programming of SoMachine

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- Start the computer and launch "SoMachine".
- **O** Create a new project by clicking on the icon "Cretae a project".
- Choose an "empty project".
- Give a name to your project.
 - **₩** "OK".

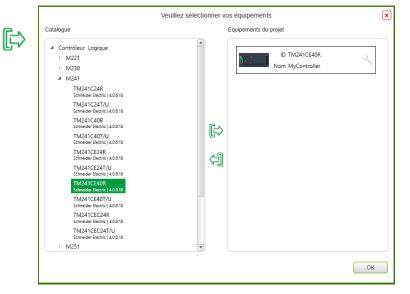
	Nouveau	×
Modèles Projet vide Elibiidhèque vide		
Créez un projet vide.		
Nom ERMET		
		OK Annuler

U Double-click on the icon "Configuration".

● In the browser "Catalogue", choose your "Contrôleur Logique". The type of processor is given in front of the PLC M241.

• Move the "Contrôleur Logique" in "Equipements du projet" using the arrow.

₩ "OK".



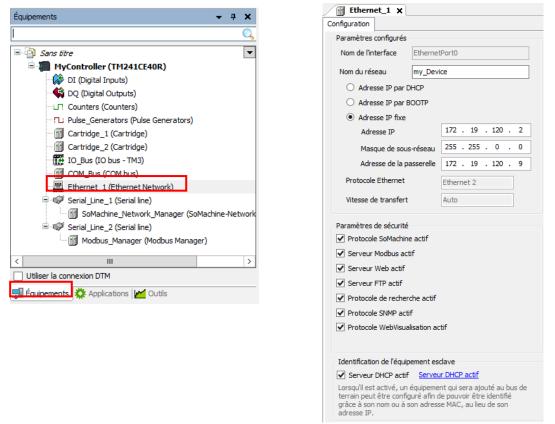
• Double-click on "Contrôleur".





• In the "Equipment" tab, double-click on "Ethernet 1 (Ethernet Network)" :

U Enter the fixed IP address as below in order to communicate with the PLC via an Ethernet port :



● In the "Equipement" tab, click on the S of "IO Bus (IO bus - TM3)":

O Choose your digital output extension module. The type of TM3 module is indicated on the front of the module at the PLC.

	Actio	n:			
Sans titre	• Aj	jouter un appareil 🔿 Insérer un a	appareil 🔘 Brancher app	areil 🛛 Actualiser l'appare	il i
🚊 🌆 MyController (TM241CE40R)	Appa	reil :			
DI (Digital Inputs)	Four	nisseur : Schneider Electric			
	Nor	m	Fabricant	Version	
📲 😡 (Digital Outputs)		TM2 - Modules d'E/S numériq			
Counters (Counters)		TM3 - Modules d'E/S analogic			
Pulse_Generators (Pulse Generators)		TM3 - Modules d'E/S expertes TM3 - Modules d'E/S numériq			
Cartridge 1 (Cartridge)		 In the uncertained of the uncertained			
		🗉 🔟 Mixte			
🗂 Cartridge_2 (Cartridge)		🖻 🔟 Sorties			
IO_Bus (IO bus - TM3)	•	TM3DQ16R/G	Schneider Electric	1.0.1.4	
COM Bus (COM bus)		IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Schneider Electric Schneider Electric	1.0.1.4	1
		TM3DQ16U/G	Schneider Electric		
Ethernet_1 (Ethernet Network)		■ TM3DQ16UK	Schneider Electric	1.0.1.5	
📮 💞 Serial_Line_1 (Serial line)		TM3DQ32TK	Schneider Electric		
SoMachine_Network_Manager (SoMachine-	Network	IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII	Schneider Electric Schneider Electric		
Serial_Line_2 (Serial line)		IM3DQ8R/G IM3DQ8T/G	Schneider Electric	1.0.1.4	
		TM3DQ8U/G	Schneider Electric	1.0.1.5	
🛄 Modbus_Manager (Modbus Manager)					
	/ Add a dev	ice". Ajou	ter un appare	il	
"Ajouter un appareil"Fermer/ Close".	Fermer				
			Applications		• •
					•
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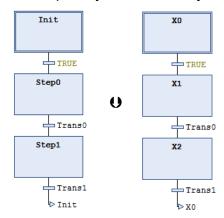
Global

🗐 Équipements 🗱 Applications 📈 Outils

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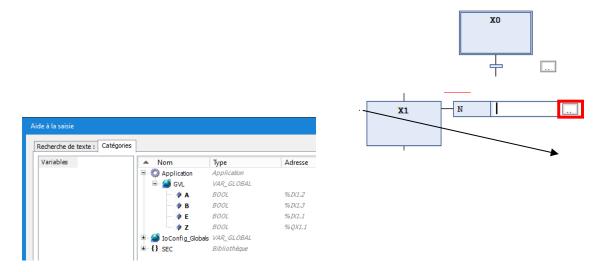
$oldsymbol{\Theta}$ Using your I/O table, fill in the assignment of	of all the PL	Ca	iddresses of eac	h l/	0.
For the input variable * "NomVari	able AT %I>	(*.:	*: BOOL;"		
For the output variable * "NomVar	iable AT %C)X	*.*: BOOL; "		
Ex : - The input variable "E" affectée à l'adres - The output variable "S" affectée à l'adre <mark>Make sur the teac</mark>	sse %QX1.′	d	e l'API. U	1 2 3 4	VAR_GLOBAL E AT %IX1.1: BOOL; S AT %QX1.1: BOOL; END_VAR
To open a programmation tab:	Applications		- + X		VAR_GLOBAL
• Right-click on "Application (MyController :)	Sans titre	- V	Couper	3	E AT %IX1.1: BOOL; S AT %QX1.1: BOOL; END_VAR
	MAST		Copier Coller		
"Add an object"	Équipements		Supprimer Propriétés Ajouter une fonction à partir du modèle		
* "POU"	Compiler Description Affecter un type à un co Ø MyController : POU man Ø Pas d'appel POU dans la La compilation est term Ajouter POU Cré Nom :		Ajouter un objet Ajouter un appareil Insérer un appareil Recherche d'appareils Résumé E/S Consommation d'énergie Ajouter un dossier Modifier l'objet Modifier l'objet avec Connexion ConfigurationAvancée X suveau POU		Collection d'images Configuration de symbole Configuration des données Web DataLogManager DUT Enregistrement de suivi Gestionnaire de recettes Gestionnaire de visualisation Interface Liste de textes Liste de variables de réseau (destinataire) Liste de variables de réseau (expéditeur) Liste de variables globales OPC UA Symbol Configuration POU POU POU pur vérifications implicites Table de réaffectation Variables persistantes
In tbhe window "Add a POU" :	Programme Type :				
Write a name.	Prog Bloc Ét				
Choose "SFC" as implementation language	Modif	plémen cateur	d'accès		
₩ "Add"	Lang Fonc Type Langage di	ge à O tion de reto npléme	ntation : nnel en Séquence (SFC)	-	
• Enter the skeleton of your Grafcet using th	e graphic pa	ie	Ajouter Annuler		
TP 🖨 다 부 부나 집 한 혐	9 말	t	≖i lo† loi		<mark>算† </mark> 10 / 14

O Rename the steps of your Grafcet by X0, X1, X2... like in the example below :

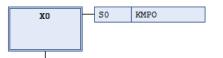


O Enter the receptivities and the actions of your Grafcet.

You can also click on the white rectangle next to the receptivity or the action and choose the the desired variable in the "GVL" as below.



• Enter the setting of variable "KMPO" at step "X0" in order to switch on the safety contactor.



• Drag your program into the "MAST" folder with a long left click so that it can be executed.



- Compile your program by clicking on or on "F11".
- You'll see a warning message that is not important, click on "Alt+F".

			🔯 Avertisse	ment	×
Note : If there's any and compile your p	mistake, correct them rogram again.		<u>.</u>	AVERTISSEMENT FONCTIONNEMENT INATTENDU DE L'EQUIPEMENT	
			sorties d	gramme contient un addressage direct des entrées et/ou e votre controlleur (%IX, %IB, %IW, %ID, %IL, %QX, %QB, QD ou %QL).	des
				lire et d'appliquer les informations fournies dans la note de	Ð
			Schneid faciliter l	er recommande l'utilisation de l'adressage symbolique pour a modification et la maintenance d'application.	t
				espect de ces instructions peut entraîner la mort, des s graves ou des dommages matériels.	
			Si vous	acceptez de suivre ces instructions, appuyer sur 'Alt+F'.	
				Annuler	
• Connect to the P	LC by clicking on	or by	y click	ing on "Connexion".	
Several messages v	vill appear				
Several messages v		SoMachine	Logic Builde	er (×
O Click on "Yes"	*		TM241CE40	us vraiment ouvrir une session sur le nœud R @0080F43F17A9' avec l'adresse	
			0000.9000.7	302.8004' ?	
				<u>O</u> ui <u>N</u> on	l
		SoMachin	e Logic Buil	der	
	*	?	actuelleme	ent : une version inconnue de l'application « App nt sur l'automate. Souhaitez-vous cependant cha 'application existante ?	
				Oui Non	Déta
• Put the PLC on "	RUN" by clicking on "	Start".		🎬 🧐 🥰 💽 =	
● Click on "Yes"	SoMachine Logic Builder			×	
	Souhaitez-vous réellement e	exécuter l'o	pération « I	Démarrer » ?	
		0	ui	Non	

You can test your program

• To stop or make a change to the program, click on "Stop" and then on "Disconnect". .

\`````

• Modify your program and redo the steps from compilation to RUN.

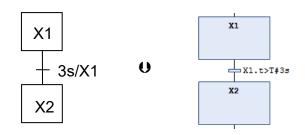
ANNEXE 2 – Ecriture d'une temporisation

Here is an example of a temporization which is triggered at the step X1 of a grafcet and which lasts 3 seconds.

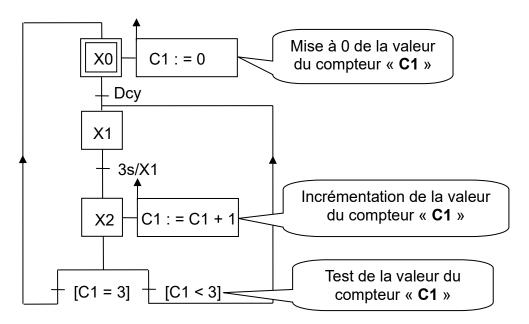
This writing is placed at the level of the receptivity where you test the temporization.

With this method one tests the value of the time which elapses from the moment when the stage X1 was activated "X1.t".

When this value becomes greater than 3 seconds "T#3s", then the receptivity of the transition between step X1 and step X2 becomes true, the transition is validated and therefore can be crossed.

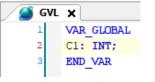


ANNEXE 3 – Ecriture d'un compteur

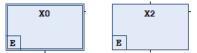


First of all, you have to declare a variable of type "integer" (INT) corresponding to the value of the counter. It can be named as you wish, in the example, this variable is named "C1" for Counter n°1.

• In the "GVL" window, enter the variable "C1" of type "INT" as below:



Zeroing "C1:=0" and incrementing the counter "C1:=C1+1" must be done when the step is activated (input action)



- To set the counter to 0:

• Click on the "X0" step and using the graphics palette, click on "Add Input Action":

xo E Applicat Ajouter une action	Ajouter une action d'entrée	
The writing of the set to 0 "C1:=0" must be done in the programming language "Structured Literal" (ST) programming language	Nom : X0_entry Langage dimplémentation : Littéral Structuré (ST)	
In the "Add input action" window:		
Leave the default name.		
Choose as implementation language "ST".		
♥ "Add"	Créer une nouvelle action Ajouter Annuler	
In the window :		
• Write the equation "C1:=0" in Structured Literal (S	T) Programme.X0_entry X	

- Note: an action always ends with a ";". 1 C1:=0;
- For the incrementation of the counter, it is the same method as the setting of the counter to 0:

X2 -	[中] 다 ♀↑ ♀↓ 古 다 · Applica' Ajouter une action d'entrée	
Ajouter une ac	ion d'entrée	x
	Nom : [X2_entry Langage d'implémentation : [Littéral Structuré (ST)	~
*	Programme.X2_entry X 1 C1:=C1+1;	

-Both tests are written in the same way but without the brackets as below:

[C1<3] U C1<3

[C1=3] • C1=3

